NOTE: The Geospatial Technology Applications Center (GTAC) was formed through the integration of the Geospatial Service and Technology Center (GSTC) and the Remote Sensing Applications Center (RSAC), and is an organizational component of the Geospatial Management Office (GMO).
The National Remote Sensing Program

The National Remote Sensing Program provides subject matter expertise to a wide range of agency business areas including; Engineering, Fire & Aviation Management, Forest Health Protection, Research and Law Enforcement & Investigations.

The position provides remote sensing leadership and direction to the Geospatial Management Office (GMO) Program Managers, Forest Service regions and field units, and the Geospatial Technology Application Center.
Interagency Forums

Tactical Fire Remote Sensing Advisory Committee (TFRSAC)

The TFRSAC is a civil interagency committee which facilitates the evaluation and transfer of remote sensing technology for wildland fire applications. This TFRSAC core committee consists of the USFS and NASA stakeholders who collaboratively guide the research and demonstration directions of the science team. Partners on this committee participate in twice yearly committee meeting to coordinate and facilitate technology transfer elements as they relate to fire imaging, data ingestion, data processing, and data and information decision support system integration and utility.

Next meeting: May 2017 (date TBD) / NASA Ames Research Center
Interagency Forums

Thermal Working Group (TWG)

- Provide a working-level forum that focuses on marketing and awareness of thermal detection and reporting capabilities of the IC and Civil communities.
- Provide advocacy, oversight and prioritization of capability needs, end-to-end readiness activities of future capabilities and assist with enabling technology insertion.
- Document civil community requirements for the receipt of IC-produced products.
- Coordinate on the capability evolution of systems with research and development (R&D) and acquisition.
- Coordinate the appropriate policy approvals to ensure timely dissemination to Civil consumers of IC-produced products.
- Provide a forum that will elicit and provide customer feedback.
- Facilitate the coordination and operationalization of civil applications of IC-provided capabilities.

Last meeting: Thermal Summit / Feb 2017 / SAIC in Chantilly VA
Next meeting: Occur every 2 years or earlier as needed
The goal of these interagency forums is to advance the use of remote sensing technology in the wildland fire arena in a reliable way in order to:

1. Support decision support for all phases of fire (useful tactical intelligence), and

2. Provide actionable intelligence in a timely manner to keep the fire fighters safe, to keep the public safe, and to protect assets at risk and to protect our natural resources.
GTAC Disturbance Assessment and Services (DAS) Program Support

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Tactical Fire Mapping Support
(https://fsapps.nwcg.gov/nirops)

- “NIROPS” - National Infrared Operations Unit
- Provides daily high resolution airborne IR imaging
- Facilitates fire detection/mapping products to support incident command operations

GTAC Support Functions:
- Maintenance
  - NIROPS website
  - IR ordering system
  - Operations Users Guide
  - IR Vendor listing
- Phoenix sensor tech support
- Technology evaluation
- IRIN incident support
- IRIN training
Tactical Fire Mapping Support

Typical NIROPS Workflow

• Phoenix imagery acquired by two agency aircraft

• Ortho-imagery delivered via AirCell for immediate access by IRINs

• Suite of high resolution, daily fire products provided to IMTs
  • Shapefiles, KMZs, maps

• Products inform incident management decisions for upcoming operational period
Tactical Fire Mapping Support Updates

1,495 nationwide requests filled by NIROPS in CY2016

Western U.S. missions by 144Z and 149Z through 1st week of Oct 2016
Tactical Fire Mapping Support Updates

- **Autonomous Modular Sensor (AMS)**
  - Hardware updates and testing ongoing
  - OBP and PMP system developments, refinements and integration ongoing
  - 2017 FS testing/integration missions possible, but not anticipated
  - Anticipate readiness for 2018 fire science campaigns
    - Fire and Smoke Model Evaluation Experiment (FASMEE), etc.
2016 Planned Forest Service UAS Missions

1. North Fire Support / Cibola NF (June)

2. Eurasian Milfoil Mapping / Fishlake NF (September)

3. FHP/FM Aerial Survey / Apache-Sitgreaves NF (September)

4. Blackjack/Bluebird Mine Aerial Survey / Umatilla NF (October)

5. Champion Mine Aerial Survey / Umpqua NF (October, postponed)

6. Pioneer Fire Post-Fire Aerial Survey / Boise NF (October, postponed)
FHP/FM Aerial Survey Mission

• Location: Hannagan Meadow (Apache-Sitgreaves NF)
• Project Area: 200 acres
• Objective(s):
  • Acquire high resolution (2 inch) multispectral imagery
  • Evaluate use of imagery and derivative products to cost effectively:
    • Detect and monitor outbreaks of native and/or exotic forest pests
    • Estimate forest biomass parameters
    • Evaluate contracting for UAS and use of UAS within FS aviation system
• Mission Date(s): September 12-15, 2016
• Mission Type: Contracted
  • Ryka UAS Services (FAA 333 exemption)
FHP/FM Aerial Survey Mission

Platform
Matrix Turbo Ace Quad Copter
• Power: Electric
• Size: 39.3” x 15.5”
• Weight: 3.5 lbs
• Payload Weight 5 lbs
• Endurance: 15-45 minutes
• Speed: 60 mph

Sensor Payload
RGB/Near Infrared Camera
• MicaSense Red Edge
• Spectral Response: 0.4µm – 0.85µm
• Resolution: 3” at 400’ altitude
FHP/FM Aerial Survey Mission
FHP/FM Aerial Survey Mission

Natural color frame

Color infrared frame

Color infrared image mosaic
FHP/FM Aerial Survey Mission

Natural color encoded point cloud
Active Fire Mapping (AFM) Program
(https://fsapps.nwcg.gov/afm)

- Implemented at GTAC in 2001
  - Continuous support by NASA & mission science teams

- Operational near real-time (NRT) satellite data/mapping/visualization products for **strategic** wildfire management
  - “Value-added” products
  - All lands and ownerships in U.S. and Canada

- Facilitates situational awareness and wildfire decision support
  - Prioritize allocation of suppression assets
  - Focus tactical reconnaissance assets
  - Key data input to several fire-related operational applications
Satellites/Sensors Currently Used by AFM

- **GOES Imager**
  - Fire detection spatial resolution: 4000m
  - Temporal resolution: Every 15 min
  - Relative Ground Swath: > 8000 km swath (entire Earth disk)

- **S-NPP VIIRS**
  - Fire detection spatial resolution: 375m and 750m
  - Temporal resolution: Twice daily from one sensor
  - Relative Ground Swath: 3000 km swath

- **NOAA AVHRR**
  - Fire detection spatial resolution: 1100m
  - Temporal resolution: 6 times daily from 3 sensors
  - Relative Ground Swath: 2700 km swath

- **Terra/Aqua MODIS**
  - Fire detection spatial resolution: 1000m
  - Temporal resolution: 4 times daily from 2 sensors
  - Relative Ground Swath: 2300 km swath

- **Landsat 8**
  - Fire detection spatial resolution: 30m
  - Temporal resolution: Once every 16 days
  - Relative Ground Swath: 185 km swath

- **GOES Imager**
  - Geostationary
  - Morning Orbit
  - Afternoon Orbit
Emerging Satellites/Sensors of Interest to AFM

GOES R/S ABI
- Fire detection spatial resolution: 2000m
- Temporal resolution: Every 5 min
- > 8000 km swath (entire Earth disk)

JPSS VIIRS
- Fire detection spatial resolution: 375m and 750m
- Temporal resolution: Twice daily from one sensor
- 3000 km swath

Sentinel 3A/3B - SLSTR
- Fire detection spatial resolution: 1000m
- Temporal resolution: Once daily from one sensor
- 1675 km swath

GCOM-C - SGLI
- Fire detection spatial resolution: 500m
- Temporal resolution: Once every 1-2 days from one sensor
- 1400 km swath

Sentinel 2A/2B - MSI
- Fire detection spatial resolution: 20m
- Temporal resolution: Once every 5 days (or less) from 2 sensors
- 290 km swath

- GOES-R (GOES 16) launch date: November 2016
- JPSS-1, 2, 3 & 4 launch dates: September 2017, 2021, 2026 and 2031
- Sentinel 3A/3B launch dates: February 2016 and late 2017
- GCOM-C launch dates: 2017, 2018 & 2022
- Sentinel 2A/2B launch dates: June 2015 and mid 2017
Algorithm Research to Operations, Maintenance and Update

International Polar Orbiter Processing Package (IPOPP)

- Autonomous multi-mission, multi-sensor data processing framework
- Plug-and-play execution of Science Processing Algorithms (SPAs), or run stand alone
- Facilitates consistent SPA implementation and easy SPA use/maintenance
- Configurable/scalable to user needs

Recent/Ongoing SPA Examples

- VFIRE375
- VIIRS-AF
- MODIS & VIIRS burn scar
- MAIAC
- SMAP soil moisture
GTAC MODIS/VIIRS NRT Data Processing

- **MODIS/VIIRS Direct Readout Ground Station Network**
  - Selected MODIS L0/L2 & VIIRS RDR/EDR Data (~30 minutes after acquisition)

- **L0/RDR Data**
  - Low Latency NASA MODIS/VIIRS Data Stream
    - L0 & L2/EDR Data (every 15 minutes)

- **USFS-GTAC IPOPP Processing System(s)**
  - NASA International Polar Orbiter Processing Package (IPOPP)
    - MODIS L0 -> L1 -> L2 processing
    - VIIRS RDR -> SDR -> EDR processing

- **L2/EDR Product Stream for U.S. and Canada**

- **Value-added Mapping/Visualization, Data & Analysis Products for Dissemination**
2016 NASA Direct Readout Conference (NDRC)

- NDRC-9 took place June 21st – 24th, 2016 at Valladolid, Spain
- Host: Laboratorio de Teledeteccion (LATUV) – University of Valladolid
- Sponsors/Organizing Committee:
  - EUMETSAT* (ITWG)
  - WMO
  - USDA Forest Service* (ILDRCC)
  - Oregon State University* (IDROSC)
  - University of Wisconsin/SSEC* (ITWG)
- Registered Attendees: 180
  - 35 countries represented
- Structured to provide Plenaries and Workshops
  - **Plenaries** for the world to present what they are doing with NASA’s data
  - **Workshops** to further enable NASA’s data use for decision support systems
- Presentations/Posters/Proceedings
  - [https://directreadout.sci.gsfc.nasa.gov/?id=dspContent&cid=244](https://directreadout.sci.gsfc.nasa.gov/?id=dspContent&cid=244)
Burned Area Emergency Response (BAER) Support
(http://www.fs.fed.us/eng/rsac/baer)

• Provide rapid delivery of imagery and derived products to Forest Service BAER teams
  • Conducted on fires exceeding thresholds for size, severity and/or soil resource damage

• Burned Area Reflectance Classification (BARC), preliminary vegetation burn severity, based on dNBR/dNDVI assessment

• BAER teams use BARC with field observations and other spatial data to generate a soil burn severity map

• Soil burn severity map used to target and mitigate hazards to life and property

• All available moderate resolution satellite assets are used

• Imagery and data products available within 24 hours of image availability
Burned Area Emergency Response (BAER) Support Updates

- 103 requests completed in CY 2016; 1.1 million acres mapped

- EO-1 mission decommissioned in February 2017
  - ALI imagery no longer available for BAER support

- Sentinel 2A/2B imagery to be integrated when available at suitable latency
Rapid Assessment of Vegetation Condition after Wildfire (RAVG)
(http://www.fs.fed.us/postfirevegcondition)

• Provide **Landsat** imagery and derived products to silviculturists characterizing fire effects on forest resources
  • Conducted on fires where > 1,000 acres NFS forested land cover is affected
  • Assessment based on **RdNBR** – a variant of dNBR - to derive post-fire forest condition layers
    • Burn severity
    • % basal area loss
    • % canopy cover loss

• Inform post-fire reforestation management and resource prioritization decisions
• Provided ~45 days after fire containment
Rapid Assessment of Vegetation Condition after Wildfire (RAVG) Updates

• 100 fires mapped in CY2016 covering > 1.1 million acres

• 14 late season southeast U.S. fires yet to be completed

• Threshold change for eastern U.S. fires
  • > 500 acres of NFS forested land cover affected

• Planning to collect additional field data for RAVG models

• Coordination ongoing with USGS to provide RAVG for DOI fires

2016 RAVG assessment poster will be updated when remaining SE U.S. fires are completed
Monitoring Trends in Burn Severity
(http://www.mtbs.gov)

- FS and USGS provide **Landsat** imagery and derived suite of products for all large fires
  - > 1,000 acres in western U.S.
  - > 500 acres in eastern U.S.
- Post-fire extent and burn severity layers based on dNBR assessment
- Products are used to support:
  - Assessment of fire/severity trends
  - Assess effectiveness of national fire management policies
  - Land cover product updates
  - Resource management and monitoring activities
- Data record spans from 1984 to present
Monitoring Trends in Burn Severity Updates

- Year 2015 fires to be released soon
- Will provide access to > 20,000 fires covering > 155 million acres
- Mapping of additional historical fires recently completed by USGS
- Investigation of new technologies to optimize map production
  - USGS ARD
  - Cloud processing, analysis & computing services
- Evaluation of Sentinel 2A/2B imagery for data record continuity
Take Home Message

FS operational wildfire support programs and research to operations initiatives are not possible without NASA support... so thank you NASA!!!

• NASA Goddard Space Flight Center
• NASA Ames Research Center
• NASA Jet Propulsion Laboratory
• NASA Headquarters
Thanks!

Geospatial Technology and Applications Center (GTAC)